Provincial Report

Mathematics 30
Grade 12 Diploma Examination

September 1984

Student Evaluation

Alberta
EDUCATION

DISTRIBUTION:

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TABLE OF CONTENTS

LIST OF TABLES

PREFACE

This report presents the provincial results of the Mathematics 30 Diploma Examination administered on June 27, 1984. During this second administration, the Mathematics 30 Diploma Examination was written by 9151 students. This report provides information about the examination development process, the examination itself, and the examination results.

ACKNOWLEDGMENTS

This second administration of the Mathematics 30 Diploma Examination was successful due to the concerted effort of all involved. Success would have been impossible without substantial contributions from many people, particularly the administrators, teachers, and students, who extended their full co-operation.

The technical expertise and advice received from the Examination Review Committee regarding design, development, and reporting have been particularly valuable in the implementation of this diploma examination. This Committee has representation from:

The Alberta Teachers' Association
The Conference of Alberta School Superintendents
The Universities Co-ordinating Council
The Public Colleges of Alberta
Alberta Education

The contribution of this group is gratefully acknowledged.

Lloyd E. Symyrozum
Director
Student Evaluation Branch

CHAPTER 1

Grade 12 Diploma Examinations Program

Introduction

All Grade 12 students in Alberta are now required to write at least ONE diploma examination to receive a high school diploma. Mature students may receive credits for a Grade 12 course by writing the appropriate diploma examination. They are not required to be registered in the course. The Grade 12 Diploma Examinations Program, which is an integral part of the high school diploma requirements, is intended to develop and maintain excellence in educational standards through certification of academic achievement.

The Diploma Examinations Program consists of course-specific examinations that are based on the prescribed *Program of Studies for Senior High Schools* for the following Grade 12 courses: English 30, English 33, Social Studies 30, Mathematics 30, Biology 30, Chemistry 30, and Physics 30.

Alberta Education issues two distinct high school diplomas: the General High School Diploma and the Advanced High School Diploma.

General High School Diploma

To earn a General High School Diploma, a student must obtain course credit in either English 30 or English 33, and obtain 100 credits distributed over courses as specified in the *Junior-Senior High School Handbook*. Some students who are working toward the general diploma may wish to obtain credits in other diploma examination courses (i.e., Social Studies 30, Mathematics 30, Biology 30, Chemistry 30, and Physics 30). To obtain credits in these courses, a student must also write the appropriate diploma examination regardless of the type of diploma he wishes to receive.

Advanced High School Diploma

The Advanced High School Diploma represents achievement in an academic program that includes language arts (English), social studies, mathematics, and science. To earn an Advanced High School Diploma, a student must satisfy the current course and credit requirements for a General High School Diploma, and obtain course credits in English 30, Social Studies 30, Mathematics 30, and ONE of Biology 30, Chemistry 30, or Physics 30.

Awarding of Course Credits

Grade 10 and Grade 11 Courses. To obtain credits in Grade 10 (10-level) and Grade 11 (20-level) courses, a student must earn a final mark of 40% or better. A student who has achieved a mark of 50% or higher in a given course is eligible to take the next or higher-rank high school course in that sequence.

Grade 12 Courses. To obtain credit in a Grade 12 (30-level) course, a student must earn a final mark of 50% or better. To obtain credit in a Grade 12 diploma examination course, a student must write the appropriate diploma examination and attain a final blended mark of 50% or better. The final blended mark is made up of 50% of the mark awarded by the school and 50% of the diploma examination mark. For example, a student taking Mathematics 30 might have a mark of 45% from his school and a mark of 57% on the diploma examination. This student would earn credits for Mathematics 30 because his final mark would be 51%, which is the average of the school and examination marks. For mature students who do not have a school mark or who have a school mark lower than the examination mark, the examination mark is the final mark.

Transitional Provisions

During the 1983/84 school year, Alberta Education will recognize all course credits earned prior to September 1, 1983, for the purpose of awarding the General High School Diploma.

A student who has completed partial requirements for the Advanced High School Diploma prior to September 1, 1983, and who is enrolled in Grade 12 courses during the 1983/84 school year, may apply any of the previously completed required diploma examination subjects toward a diploma provided that the student has earned a final course mark of 50% or better in each subject.

Award of Excellence

When candidates for an Advanced High School Diploma obtain a final average of 80% or higher on the four required diploma examination courses with not less than 65% in any one of these four required courses, they receive an Award of Excellence. This Award of Excellence is noted on the student's Advanced High School Diploma.

When a student writes two or three of the diploma examinations in Biology 30, Chemistry 30, and Physics 30, the highest of these final course marks is used for diploma purposes and in the calculation of the average for the Award of Excellence.

CHAPTER 2

Description of the Examination

This chapter outlines the procedures that were followed during examination development, and discusses the structure and content of the examination. Sample questions from the June 1984 examination are included.

Examination Development

There were three stages in the development of the June 1984 Mathematics 30 Diploma Examination: preparation of curriculum specifications, development of questions, and selection of questions for the final copy.

1. Curriculum Specifications

   The Curriculum Branch of Alberta Education prepared curriculum specifications based on the topical outline of the Mathematics 30 core described in the *Program of Studies for Senior High Schools*. In these specifications, weightings were assigned to each major content area and to specific topics outlined in the *Program of Studies*. These weightings were based on the emphasis that each topic was to receive in the Mathematics 30 program. The curriculum specifications were distributed to all school jurisdictions in the province.

   Topic statements upon which specific examination questions were based, along with sample questions for each topic, are given in this chapter.

2. Development of Questions

   Committees composed of teachers and Student Evaluation Branch personnel wrote questions to reflect the content statements listed in the curriculum specifications. The questions were field-tested, and revisions were made on the basis of teacher recommendations and the field-test results.

3. Final Copy

   A test development specialist, assisted by groups of classroom teachers, built the examination from suitable questions. These committees selected questions from the various content areas so that each area received the emphasis recommended in the curriculum specifications. An Examination Review Committee checked the proposed examination for content validity, accuracy, and technical merit, and further changes were made in accordance with their recommendations.

Examination Description

The Mathematics 30 Diploma Examination addressed all core topics of the course. The per cent emphasis placed on each topic reflects the examination specifications sent to the schools by the Student Evaluation Branch.

Content Area	Emphasis in % of the Total Examination Mark
Trigonometry	22
Quadratic Relations	22
Sequences, Series, and Limits	18
Statistics	15
Logarithms	12
Polynomial Functions	11

The examination consisted of parts A and B. Part A consisted of 52 multiple-choice questions worth 80% of the total examination mark. It covered the six subject strands of trigonometry; quadratic relations; sequences, series, and limits; statistics; logarithms; and polynomial functions. The questions measured the four cognitive levels of knowledge, comprehension, application, and open search. Knowledge questions test recall of facts, definitions, rules, theories, and the ability to do routine computations. Comprehension questions test understanding of principles and concepts, interpretation, translation, and the ability to perform algorithms. Application questions test the ability to solve type problems. Open search questions test the ability to solve novel problems, prove new results, and transfer knowledge to a context in which there has been no practice.

Part B consisted of five written-response questions worth a total of 13 marks, which represented 20% of the total examination mark. It covered the five subject strands of trigonometry; quadratic relations; sequences, series, and limits; logarithms; and polynomial functions. The questions measured three of the four cognitive levels: comprehension, application, and open search.

The cognitive classification of examination questions depends on the manner in which the content has been covered in the classroom. A question that is an application question for one class may be a knowledge question for another class.

The time allotted for writing the Mathematics 30 Diploma Examination was two and one-half hours.

The classification of questions according to subject strand and cognitive level is presented in Table 1.

Table 1

June 1984 Mathematics 30 Diploma Examination Blueprint

Subject Strand	Question by Cognitive Level				Examination Emphasis
	Knowledge	Comprehension	Application	Open Search	
Trigonometry	1,8	2,5,3,9	4,6,7,10 [1]	11	22%
Quadratic Relations	19,20	12,14,15, 17,18,22	13,21	16 [2]	22%
Sequences, Series, Limits	25	23,26,28,29	24,30,31 [3]	30	18%
Statistics	33	32,34	35,36,37, 38,39 [4]		15%
Logarithms	41	42 [5]	40,43,44 45		12%
Polynomial Functions	46	47,49,52	48,50,51		11%
Examination Emphasis	12%	34%	45%	9%	100%

Note: Numbers in brackets [ ] indicate the written-response questions.

Description of Subject Strands and Sample Multiple-Choice Questions

The topics that were tested within each strand are listed, and sample questions from the examination are provided. The correct response for each question is identified with an asterisk, and the percentage of students selecting each alternative is given.

1. Trigonometry

Questions related to trigonometry measure the ability to:

- describe circular paths on the unit circle
- determine co-ordinates of points on the unit circle
- define trigonometric ratios in terms of co-ordinates of points on the unit circle
- find the domain and range of the six trigonometric functions
- solve simple trigonometric equations
- derive and apply trigonometric identities
- define periodic functions and radian measure
- solve problems involving sine and cosine laws

The following question is at the open search level, and measures the ability to solve a unique trigonometric problem.

Question 11:

The area of the right-angled triangle ABC in terms of hypotenuse c and angle B is

Student Responses

12.4%	A	$c^2 \sin B \cos B$
6.7%	B.	$2c \sin B \cos B$
24.3%	C.	$\frac{c \sin B \cos B}{2}$
56.4%	*D.	$\frac{c^2 \sin B \cos B}{2}$
0.2%		no response

2. Quadratic Relations (Conic Sections)

Questions related to quadratic relations measure the ability to:

- solve systems of linear equations in two variables
- state definition of the circle; derive the standard form
- convert the equation of a circle from standard to general form
- determine the equation of a circle and sketch the graph from given conditions (e.g., centre and radius; centre and a point; three points)
- define a parabola, and identify terms such as focus, vertex, axis, and directrix
- solve problems related to the parabola
- define and identify an ellipse and the terms: foci, major axis, minor axis, vertices, and focal radii
- derive the standard form of the equation of the ellipse
- solve problems related to the ellipse
- define and identify a hyperbola and the terms: vertices, foci, transverse axis, conjugate axis, and asymptotes
- derive the standard form of the equation of the hyperbola
- solve problems related to the hyperbola

The following question is at the comprehension level, and measures the ability to determine the focus and directrix for a given parabola.

Question 14:

If the equation of a parabola is $36y = x^2$, then the focus and directrix respectively are

Student Responses

65.1%	*A.	$F(0, 9)$ and $y = -9$
10.7%	B.	$F(0, -9)$ and $y = 9$
19.3%	C.	$F(9, 0)$ and $x = -9$
4.7%	D.	$F(-9, 0)$ and $x = 9$
0.1%		no response

3. Sequences, Series, and Limits

Questions related to sequences, series, and limits measure the ability to:

- recognize the difference between a sequence and a series; recognize the difference between finite and infinite sequences
- apply formulas to problems involving arithmetic sequences and series
- apply formulas to problems involving geometric sequences and series with special emphasis on the mathematics of finance
- determine the limits of various functions
- solve problems involving infinite geometric series

The following question is at the application level, and measures the ability to determine the sum of a series written in summation notation:

Question 27:

$\sum_{k=2}^{18} (4k + 3)$ is equal to

Student Responses

7.4%	A.	680
12.5%	B.	688
67.4%	*C.	731
12.4%	D.	774
0.4%		no response

4. Presentation of Data and Descriptive Statistics

Questions related to statistics measure the ability to:

- recognize measures of central tendency and measures of dispersion
- develop and apply standard deviation and z-scores
- apply probability to theoretical frequency distribution
- do probability using an experimental approach

The following question is at the knowledge level, and measures the ability to recall a basic fact about the standard deviation of a normal distribution.

Question 33:

The standard deviation for a set of N scores is S. How is the standard deviation affected when a constant, K, is subtracted from each score in the set?

Student Responses

18.6%	A.	It becomes $S - K$.
23.1%	B.	It becomes $S - \frac{K}{N}$.
46.4%	*C.	It does not change.
11.7%	D.	It decreases by $\sqrt{K}$.
0.1%		no response

5. Logarithms

Questions related to logarithms measure the ability to:

- identify and graph exponential functions
- convert equations from exponential form to logarithmic form and vice versa
- solve logarithmic equations by converting to exponential form
- state and use the basic laws or properties of logarithms for products, quotients, powers, and roots
- use logarithms to solve practical problems

The following question is at the application level, and measures the ability to solve exponential equations

Question 40:

Solve for x: $9^{4x-3} = 27^{2x+8}$

Student Responses

80.7%	*A.	$x = 15$
6.3%	B.	$x = 9$
9.5%	C.	$x = \frac{11}{2}$
3.3%	D.	$x = \frac{5}{2}$
0.1%		no response

6. Polynomial Functions

Questions related to polynomial functions measure the ability to:

- classify a polynomial function according to degree
- write polynomial functions in descending order of degree
- divide integral polynomial functions in one variable by a binomial of the form $x - a$, $a \in I$ using long division and synthetic division
- find factors of integral polynomial functions
- determine the x-intercepts of integral polynomial functions where $x \in Q$
- sketch the graph of the integral polynomial function

The following question is at the knowledge level, and measures the ability to classify polynomials according to exponents and coefficients.

Question 46:

The polynomial $P(x) = 4x^3 - 3x^4 + \frac{5}{2}x^2 - 3$ represents

Student Responses

7.4%	A.	an integral polynomial of degree 3
9.7%	B.	a rational polynomial of degree 3
32.7%	C.	an integral polynomial of degree 4
50.0%	*D.	a rational polynomial of degree 4
0.2%		no response

Written-Response Questions

Performance on written-response questions indicates the extent to which students can write the logical steps involved in the solution of a problem.

Each written-response question from the examination is given on the following pages along with an appropriate answer. The total marks possible for each question are shown, as is the average number of marks awarded. The distribution of marks awarded to students for each written-response question is shown in Table 6, Chapter 3.

Question 1 requires the student to choose the applicable trigonometric function, then use it correctly.

> The angle of elevation to the top of a building is 30°. When you move 25 m closer to the building, the angle of elevation becomes 45°. How tall is the building? (Answer to the nearest metre.)

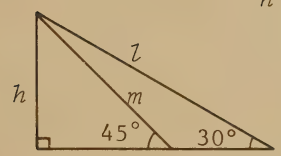
Key:

$$\frac{25}{\sin 15^\circ} = \frac{l}{\sin 135^\circ} \qquad \text{or} \qquad \frac{25}{\sin 15^\circ} = \frac{m}{\sin 30^\circ}$$

$$l = \frac{25(0.707)}{0.2588} \qquad m = \frac{25(0.5)}{0.2588}$$

$$l = 68.2959 \qquad m = 48.2998$$

$$h = 68.2959 \sin 30^\circ \qquad h = 48.2998 \sin 45^\circ$$
$$= 68.2959(0.5) \qquad = 48.2998(0.707)$$
$$= 34.147 \qquad = 34.147$$



or $h = \sqrt{\frac{m^2}{2}} = \sqrt{\frac{2332.8706}{2}}$

34 m

It was possible to score 3 marks for this question. The average number of marks awarded to students was 1.70.

Question 2 requires the student to determine the length of the minor axis of a given ellipse.

The sun is at one focus of the elliptical orbit of a comet. The farthest point of the comet from the centre of the sun is 256 million km, and its closest point is 16 million km. Determine the length of the minor axis of this elliptical orbit.

Key:

$$a = \frac{256 + 16}{2}$$

$$c = 136 - 16 = 120$$

$$b = \sqrt{a^2 - c^2}$$

$$= \sqrt{18\,496 - 14\,400}$$

$$= \sqrt{4096}$$

$$= 64$$

$$2b = 128$$

128 million km

It was possible to score 3 marks for this question. The average number of marks awarded to students was 0.97.

Question 3 requires the student to apply a geometric series formula to a problem involving the mathematics of finance.

John deposits equal semi-annual instalments in a fund that bears interest at 10% per annum compounded semi-annually. What sum must be deposited so that, immediately after the 4th deposit has been made, the balance in the account is $650?

Key:

$r = 1.05; \quad n = 4; \quad S_n = 650; \quad a = ?$

$$S_n = \frac{a(r^n - 1)}{r - 1}$$

$$650 = \frac{a[(1.05)^4 - 1]}{1.05 - 1}$$

$$650 = \frac{a(1.2155 - 1)}{0.05}$$

$$650 \times 0.05 = a(0.2155)$$

$$a = \$150.81$$

$150.81

It was possible to score 3 marks for this question. The average number of marks awarded to students was 0.65.

Question 4 requires the student to convert a given raw score into a z-score.

On a comprehensive mathematics test the mean was 55 and the standard deviation was 5. If you scored 64 on the test, calculate your z-score.

Key:

$$z = \frac{x - u}{\sigma}$$

$$z = \frac{64 - 55}{5}$$

$$z = \frac{9}{5}$$

1.8

It was possible to score 2 marks for this question. The average number of marks awarded to students was 1.60.

Question 5 requires the student to find the value of an exponent using logarithms.

Solve the equation $(3.28)^x = 0.719$ for x. Round off the answer to 3 significant digits.

Key:

$$x \log 3.28 = \log 0.719$$

$$x(0.5158) = -0.1432$$

$$x = \frac{-0.1437}{0.5158}$$

$$= -0.278$$

-0.278

It was possible to score 2 marks for this question. The average number of marks awarded to students was 0.92.

CHAPTER 3

Results

Validity and Reliability

The content validity of the examination was established by the procedure for examination development outlined in Chapter 2. Each question was mapped to a specific topic statement defining some aspect of the curriculum. The Examination Review Committee evaluated each question, and the examination as a whole, for content validity.

The KR-20 coefficient for the multiple-choice portion of the examination was 0.87, and Cronbach's alpha for the total test was 0.89. These values are very satisfactory for an achievement test measuring a broad range of concepts and skills.

The inter-marker reliability for the marking of the written-response questions was also examined. The marking key for each question was prepared by the Student Evaluation Branch and then revised following discussion with eight head markers. During the orientation session, teachers marked three common student responses for each question and discussed the awarding of marks. All teachers then marked an additional three student responses for each question so that the consistency of the marking procedures could be checked. At the beginning of each morning and afternoon marking session, all teachers marked two common student responses for each question. Any discrepancies were again discussed. For questions on those papers marked by all teachers, 97.9% of the marks awarded were in agreement, 2% deviated from the consensus mark by one mark, and 0.1% deviated by more than one mark. During the marking, one teacher marked questions 1 and 3, and a different teacher marked questions 2, 4, and 5 for each paper.

Provincial Averages

The classification of examination questions according to subject matter topic and cognitive level has been presented in Table 1, Chapter 2. Subtest scores were computed for each of the six subject matter topics, and for the four cognitive levels. Table 2 contains the provincial averages for these subtests and for the total examination. In each case, an average is given for the the written-response questions, multiple-choice questions, and the combination of the two (total). Averages are based on raw scores, which are the number of marks obtained on each subtest. The total marks possible are identified for the written-response and multiple-choice components of each subtest. For the multiple-choice component of each subtest, the average in per cent is also given.

Averages are based on the results achieved by 9151 students. Differences between total averages and component averages are due to rounding.

Table 2

Provincial Averages for Subtests

Subtest	Total Marks Possible		Raw Score Averages		
	Written-Response	Multiple-Choice	Written-Response	Multiple-Choice	Total
Subject Strands					
Trigonometry	3	11	1.7	7.0 (63.3%)	8.6
Quadratic Relations	3	11	1.0	7.5 (68.4%)	8.5
Sequences, Series, and Limits	3	9	0.6	6.2 (68.5%)	6.8
Statistics	2	8	1.6	4.2 (51.9%)	5.8
Logarithms	2	6	0.9	4.7 (78.7%)	5.6
Polynomial Functions	0	7	--	4.3 (62.1%)	4.3
Cognitive Levels					
Knowledge	0	8	--	5.3 (66.0%)	5.3
Comprehension	2	20	0.9	14.2 (71.1%)	15.1
Application	8	21	3.9	13.2 (63.0%)	17.1
Open Search	3	3	1.0	1.2 (38.7%)	2.1
Total Examination	13	52	5.8	33.9 (65.2%)	39.7

The standard deviation for the total examination was 11.5 raw score points.

The multiple-choice averages in per cent provide an indication of how well students performed within subject strands and cognitive levels. The average for the multiple-choice questions on logarithms was considerably above the overall average for the multiple-choice questions. The average for the multiple-choice questions on statistics was considerably below the overall average for the multiple-choice questions. The average for the open search questions was also very low.

It is not meaningful to compare total subtest scores or written-response subtests scores across topics or cognitive levels because of the uneven distribution of written-response questions. However, jurisdictions and schools can compare their averages to the provincial averages to help identify strengths and weaknesses in their programs.

Comparison of Multiple-Choice and Written-Response Questions

The average mark attained on the multiple-choice section of the examination was 65.1%, and the average mark attained on the written-response section was 47.2%.

In this section, each written-response question is discussed in relation to a comparable multiple-choice question.

Question 1 requires the student to choose the applicable trigonometric function, then use it correctly. The difficulty level is 0.56. Question 10, a multiple-choice question testing the same concept, has a difficulty level of 0.83.

Question 2 requires the student to determine the length of the minor axes of an ellipse embedded in the given data. The difficulty level is 0.32. Question 16, a multiple-choice question testing a similar type problem on the parabola, has a difficulty level of 0.28.

Question 3 requires the student to apply a geometric series formula to a problem involving the mathematics of finance. The difficulty level is 0.22. Question 31, a multiple-choice question testing an embedded infinite geometric series, has a difficulty level of 0.67.

Question 4 requires the student to convert a given raw score into a *z*-score. The difficulty level is 0.80. Question 36, a multiple-choice question involving *z*-score and area under the curve, has a difficulty of 0.75.

Question 5 requires the student to find the value of an exponent using logarithms. The difficulty level is 0.46. Question 43, which tests the same concept, has a difficulty level of 0.50.

Standard-Setting

Every effort was made to design a Mathematics 30 diploma examination that would be a valid and reliable measure of what students can be expected to know as a result of instruction in this course. A specific standard or level of expectation inherent in the examination was established through careful test development procedures.

To ensure equitability among marks awarded to students during the administration of each examination form for 1984, the Student Evaluation Branch adopted a process of standard-setting. One way to review the standards inherent in each examination was to involve classroom teachers in making judgments about the difficulty of the examination.

The teachers who marked the written-response portion of the examination reviewed the difficulty level of each question in terms of borderline passing students (who merit 50%). A judgment was also made regarding borderline "B" students (who merit 65%), and borderline "A" students (who merit 80%). After teachers gave their initial judgments on question difficulty, they were given information about the actual distribution of students' examination marks. They were then given the opportunity to modify their judgments.

On the basis of the data derived from the standard-setting procedure and an inspection of school-awarded marks, it was decided that transformation would not be required.

Relationship Between Examination Mark and School Mark

The provincial averages and standard deviations for the school-awarded mark, the examination mark, and the final blended mark are presented in Table 3.

Table 3

Summary Statistics for School Mark, Examination Mark, and Final Mark

	School-Awarded Mark	Examination Mark	Final Blended Mark
Average	63.1%	61.6%	63.4%
Standard Deviation	14.8%	17.6%	15.3%

The average school mark was 1.5% higher than the average examination mark. The correlation between school mark and examination mark was 0.75, which indicates a fairly close agreement in the rank-ordering of the students based on the two sets of marks.

The percentages of students receiving A's, B's, C's, and F's are presented in Table 4 for the school mark, examination mark, and the final blended mark.

Table 4

Percentages of Students Receiving A's, B's, C's, and F's

Score	School-Awarded Mark	Examination Mark	Final Blended Mark
A(80-100%)	16.6	18.1	16.8
B(65-79%)	29.9	26.5	29.0
C(50-64%)	38.0	28.0	38.9
F(0-49%)	16.4	27.4	15.3

Results for Individual Questions

Multiple-Choice Questions

The percentage of students choosing each response for each multiple-choice question is given in Table 5. The correct response for each question is also identified.

Table 5

Results for Individual Multiple-Choice Questions

Item	Key	Distribution of Responses in %*				Item	Key	Distribution of Responses in %*			
		A	B	C	D			A	B	C	D
1	B	3.4	78.0	14.9	3.7	27	C	7.4	12.5	67.3	12.4
2	A	55.5	19.3	10.0	15.0	28	B	9.7	62.4	16.5	11.2
3	D	3.1	6.6	6.7	83.5	29	A	86.3	6.0	5.0	2.7
4	B	14.0	53.3	17.7	14.4	30	D	26.3	13.5	28.8	31.2
5	D	15.4	18.2	13.3	52.8	31	A	67.3	19.8	8.6	4.1
6	A	39.8	6.2	7.0	47.0	32	B	6.2	84.5	4.2	5.1
7	C	6.7	19.5	67.2	6.3	33	C	18.6	23.1	46.5	11.7
8	D	10.9	25.9	22.4	40.6	34	D	11.1	12.9	48.8	27.0
9	C	3.4	1.7	86.3	8.6	35	B	23.3	58.0	5.0	13.7
10	D	4.1	3.6	8.8	83.4	36	D	4.1	4.1	16.3	75.4
11	D	12.4	6.7	24.3	56.4	37	B	9.1	46.2	18.5	26.0
12	B	10.2	84.5	3.0	2.2	38	A	41.6	10.3	35.0	13.0
13	A	73.7	6.6	17.8	1.8	39	B	14.5	36.1	14.8	34.2
14	A	65.1	10.7	19.5	4.7	40	A	80.7	6.4	9.5	3.3
15	B	4.5	70.8	4.1	20.6	41	B	6.9	86.1	3.7	3.2
16	A	28.6	15.4	35.2	19.9	42	A	88.9	2.8	4.2	4.0
17	D	5.7	15.0	14.3	65.0	43	C	4.5	9.1	84.2	2.1
18	C	10.4	3.3	79.9	6.3	44	B	21.1	48.9	15.9	13.9
19	A	65.8	12.5	11.8	9.9	45	B	4.5	83.3	8.7	3.3
20	C	2.5	5.3	81.0	11.1	46	D	7.4	9.8	32.6	50.1
21	B	8.2	69.8	15.6	6.2	47	A	75.5	13.4	2.7	8.3
22	D	7.4	19.7	4.4	68.4	48	C	2.8	3.8	55.8	37.5
23	A	96.1	2.6	0.7	0.6	49	C	7.4	20.7	60.5	11.2
24	C	29.8	8.9	58.5	2.8	50	C	9.6	12.3	65.6	12.3
25	D	3.9	7.7	8.2	80.2	51	C	8.5	12.2	65.9	13.0
26	B	13.2	67.4	7.9	11.1	52	A	60.9	15.3	13.4	9.2

*The sum of the percentages for each question may be less than 100% because the No Response category is not included.

Written-Response Questions

The percentage of students awarded each mark for each question is given in Table 6.

Table 6

Distribution of Marks for Written-Response Questions

Question Number	Percentage of Students Obtaining Each Mark				
	NR*	0	1	2	3
1	2.3	34.9	8.2	4.4	50.2
2	12.9	46.7	7.9	7.9	24.5
3	11.2	65.9	1.4	1.4	20.2
4	5.4	9.0	11.2	74.4	
5	14.6	35.1	8.4	41.9	

*NR - No Response

The total number of marks possible, the average mark awarded to students, and the difficulty levels for the written-response questions are summarized in Table 7. The difficulty level is the average divided by total marks possible.

Table 7

Average Marks Awarded For Written-Response Questions

Question Number	Total Marks	Average	Difficulty Level
1	3	1.70	0.56
2	3	0.97	0.32
3	3	0.65	0.22
4	2	1.60	0.80
5	2	0.92	0.46